

# Close Approaches by Vessels Elicit Surface Active Displays by Southern Resident Killer Whales



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# Abstract

Vessel disturbance has been identified as one of the potential risk factors to the endangered population of Southern Resident killer whales (SRKWs) in the eastern North Pacific. This study was conducted to determine if vessel interactions elicit behavioral responses in SRKWs. Data were collected in the San Juan Islands, USA and Gulf Islands, Canada from May through September in 2005 and 2006. Continuous behavioral data, including the performance of surface active behaviors (SABs; e.g., spy hops, breaches, tail slaps, pec slaps) were recorded from individual adult SRKWs using a focal follow approach. The total number of vessels present within 1000 m of the focal whale and distances between vessels and the focal whale were recorded every 5-10 minutes. Additionally, when whales exhibited SABs, distances between the whale and vessels were measured, and the mode of operation of the closest vessel was recorded. There was no relationship between the performance of SABs and the total number of vessels within 1000 m, yet there were relationships between the performance of SABs and vessel proximity to the focal whale. The majority of SABs were performed immediately prior to or soon after the closest approach by a vessel and occurred while the nearest vessel was motoring. In 2005, the highest frequency of SABs occurred when the nearest vessel was within 75-99 meters of the focal whale, and 70% of all SABs occurred when the closest vessel was within 199 meters of the whale. In 2006, the highest frequency of SABs occurred when the nearest vessel was within 125-149 meters of the focal whale, and 70% of all SABs occurred when the closest vessel was within 224 meters of the whale. These results suggest that close approaches by vessels elicit behavioral responses in SRKWs.

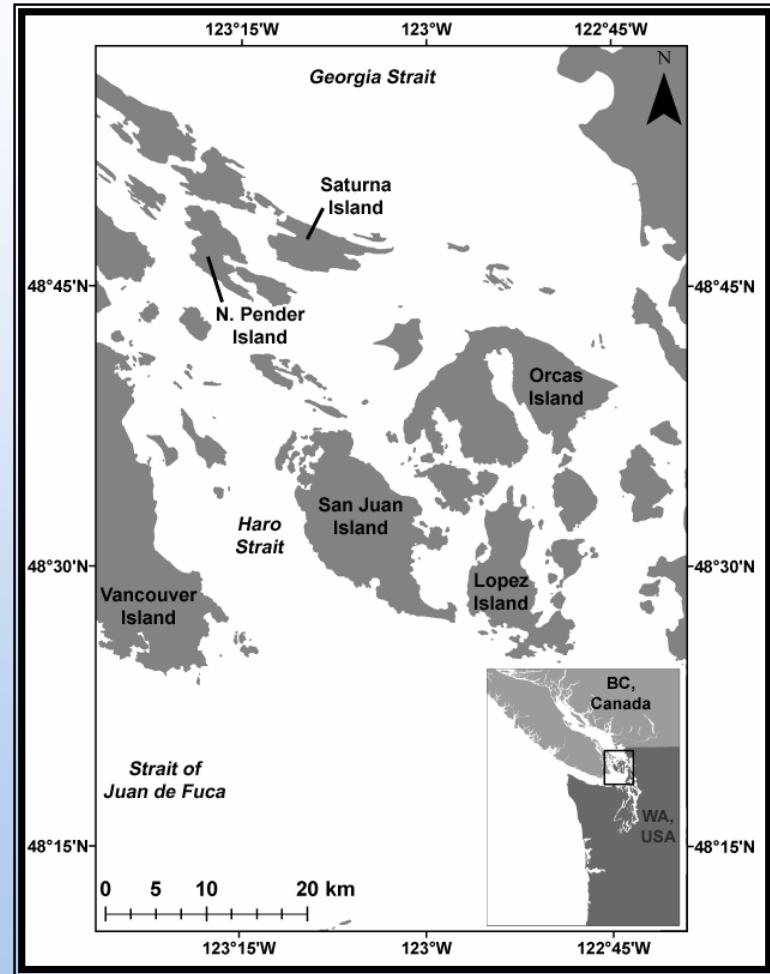
# Introduction

The Southern Resident killer whales suffered a 20% population decline from 1996 to 2001 (Krahn *et al.* 2002) and are now listed as “Endangered” under the U.S. Endangered Species Act. Vessel disturbance was identified as one of the potential risk factors to this population. Yet, it is unknown whether these whales change their behaviors while in the presence of vessels. Other cetacean species demonstrate horizontal and/or vertical avoidance behavior in response to boats (Nowacek *et al.* 2001, Williams *et al.* 2002, Lusseau 2003, Ng and Leung 2003). Agonistic surface active behaviors, such as slapping flukes or pectoral fins on the water’s surface, may also be displayed (Williams *et al.* 2002). The objective of this study was to determine if adult Southern Resident killer whales perform surface active behaviors in response to close approaches by vessels.



# Methods

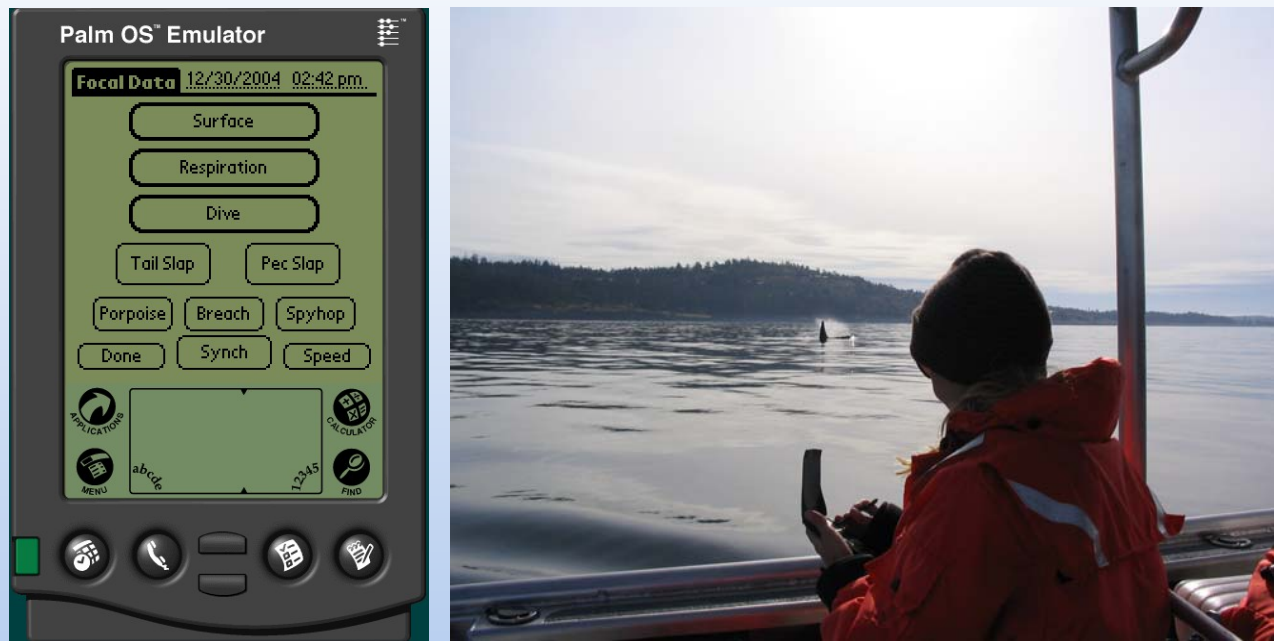
Focal follows of adult Southern Resident killer whales were conducted in the United States and Canada from May through September in 2005 and 2006.



**Fig. 1.** Map of study area in the United States and Canada.

# Methods

Data were collected from a 7.92-m Pacific aluminum skiff that maintained a distance of  $\geq 100$  m during data collection.



**Fig. 2.** Collecting behavioral and physiological data from a male Southern Resident killer whale during a focal follow using a customized Palm Pilot program.



# Methods

Surface active behaviors (SABs) performed by the focal killer whale were recorded.

- Description and time of occurrence of each SAB
- SAB bout was defined as a series of SABs in which each successive behavior occurred within  $\leq 1$  minute of the next



Tail Slap



Spyhop

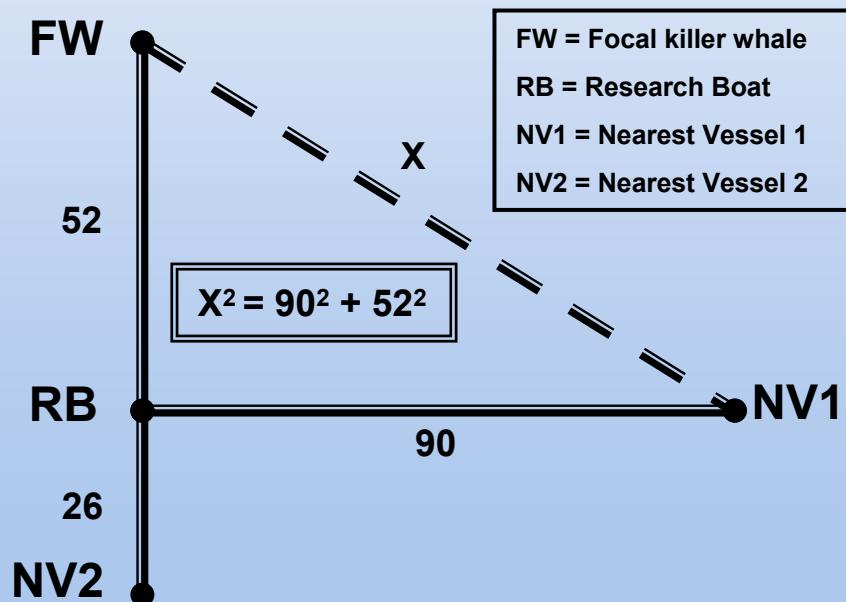


Breach

**Fig. 3.** Typical surface active behaviors (SABs) performed by Southern Resident killer whales

# Methods

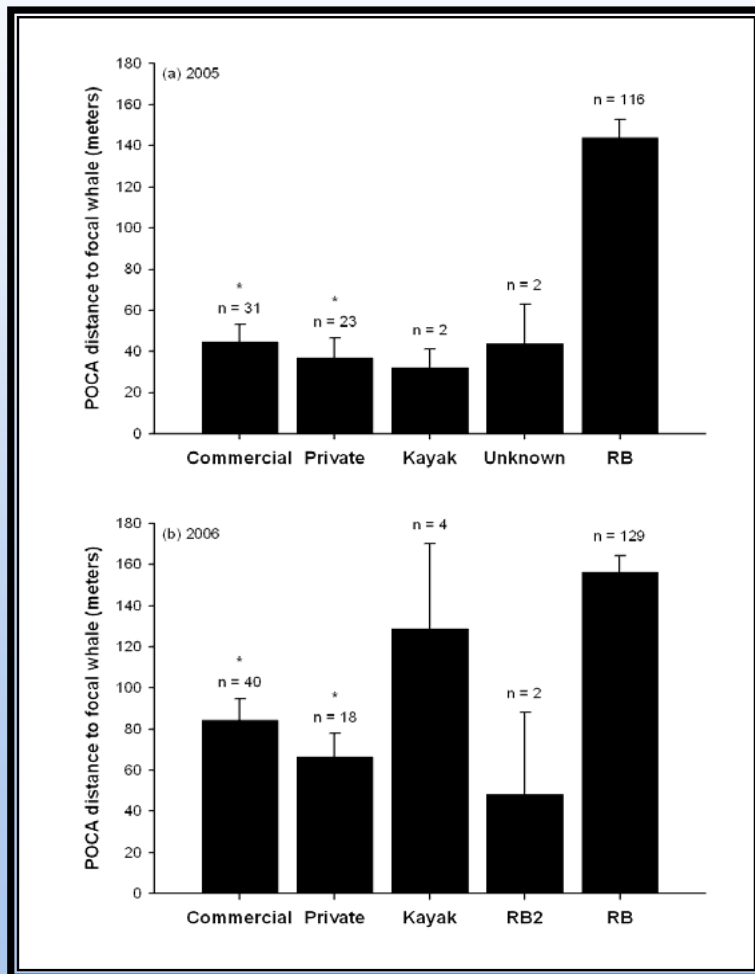
- Distances between the focal whale and vessels were recorded.
- Distances were measured from the research boat (RB) to the focal whale (FW) and to the two nearest vessels (NV1, NV2) to the focal whale with a laser range finder every 5-10 min and during every SAB
- Angles between vessels and the focal whale were estimated to the nearest 5° for each set of distance measurements
- Mode of operation (stationary shut-down, stationary idle, moving under motor) of the research boat and nearest vessels were recorded in 2006



**Fig. 4.** Schematic of how triangle trigonometry was used to calculate unknown vessel distances in relation to the focal killer whale.

# Results

## Point of Closest Approach (POCAs) during Focal Follows

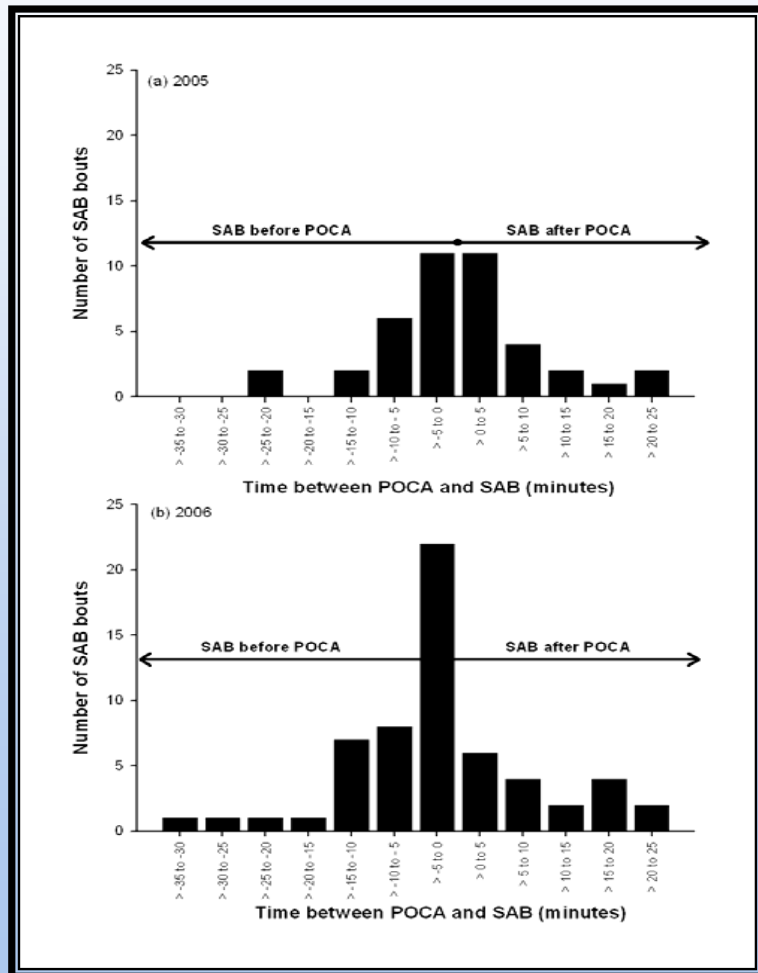


**Fig. 5.** Point of closest approach (POCA) distances characterized by vessel type in (a) 2005 and (b) 2006. The POCA for each focal follow was defined as the nearest distance between any vessel and the focal whale recorded during the entire focal follow. Mean POCA distances for commercial, private, kayak, unknown (for 2005 only), RB2 (other research boat conducting non-related study; for 2006 only), and RB (research boat for present study) are presented with +1 SEM bars. Numbers indicate the number of times each vessel type was the vessel with the POCA during a focal follow. An \* denotes that the POCA distance is significantly closer to the focal whale than the POCA distance for the RB.



# Results

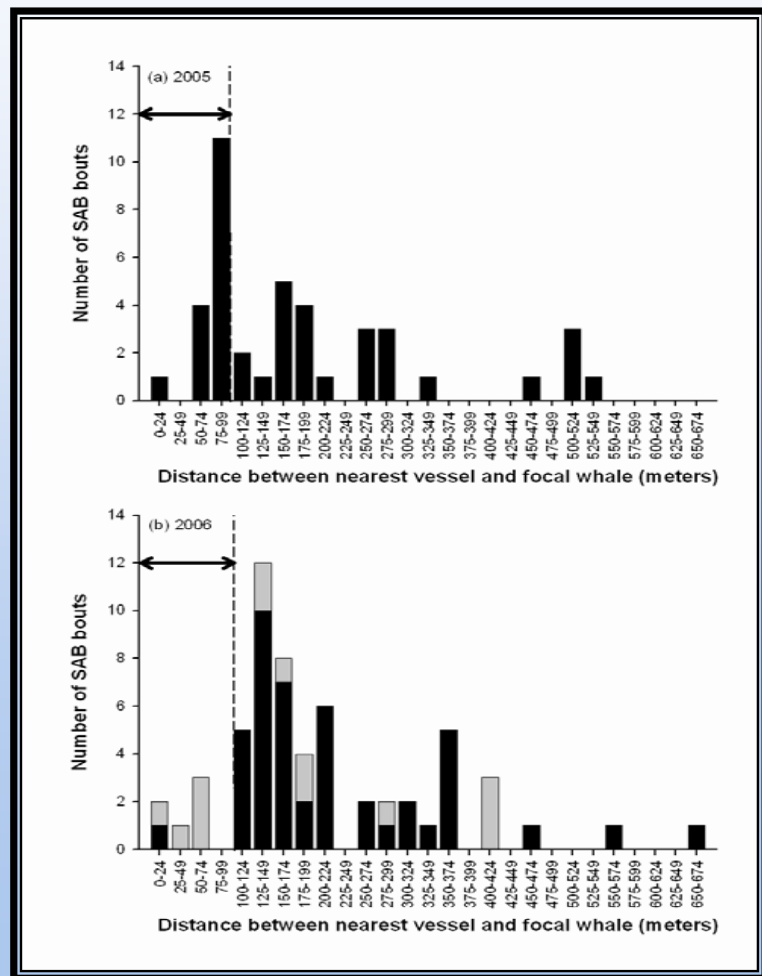
## Time Elapsed between the Occurrence of the POCA by a Vessel and the SAB Bout



**Fig. 6.** Frequency of surface active behavior (SAB) bouts in relation to the time elapsed between the occurrence of the point of closest approach (POCA) and the SAB bout in (a) 2005 and (b) 2006. The POCA for each focal follow was defined as the nearest distance between any vessel and the focal whale recorded during the entire focal follow. Time elapsed is presented in 5 minute bins. POCAs that occurred prior to SAB bouts are indicated by negative time values, POCAs that occurred simultaneously with SAB bouts are indicated by zero, and POCAs that occurred after SAB bouts are indicated by positive time values.

# Results

## Distance between the Focal Whale and the Nearest Vessel during Surface Active Behavior (SAB) Bouts



**Fig. 7.** Frequency of surface active behavior (SAB) bouts in relation to the distance between the focal whale and the nearest vessel during the SAB bout in (a) 2005 and (b) 2006. Distance is presented in 25 meter bins. In 2006, the SAB bouts are presented as stacked bars with motoring vessels designated by black bars, and stationary vessels (idling or shut-down) designated by gray bars. The 100 m/yard NO-GO ZONE, in which boaters are discouraged from approaching Southern Resident killer whales by the *Be Whale Wise: Marine Wildlife Guidelines for Boaters, Paddlers and Viewers* (Revised 2006) is shown by the dashed line and double-ended arrow for both years. The guidelines also encourage boaters to place engines in neutral if they are unable to comply with the 100 m/yard NO-GO ZONE.

# Results

## “Close” and “Far” POCA Distances during Focal Follows

**Table 1.** Focal follows with “Close” and “Far” point of closest approach (POCA) distances in (a) 2005 and (b) 2006. Percentage of total focal follows are presented in two POCA distance bins. The distance bins represent 1) “Close” POCA distances [less than and/or equal to the distance where the peak occurrence of SAB bouts occurred (75-99 m in 2005, 125-149 m in 2006)] and 2) “Far” POCA distances [greater than the distance where the peak occurrence of SAB bouts occurred ( $\geq 100$  m in 2005,  $\geq 150$  m in 2006)].

(a) 2005

POCA distance (m)	Percentage of total focal follows (FFs)
0-99	58%
$\geq 100$	42%

(b) 2006

POCA distance (m)	Percentage of total focal follows (FFs)
0-149	73%
$\geq 150$	27%

# Results

## “Close” and “Far” POCA Distances during Focal Follows with and without SAB Bouts

**Table 2.** Focal follows with “Close” and “Far” point of closest approach (POCA) distances during which the focal whale did and did not perform SABs in (a) 2005 and (b) 2006. Percentage of total focal follows within each distance bin are presented for focal follows in which the focal whale did and did not perform SAB bouts. The distance bins represent 1) “Close” POCA distances [less than and/or equal to the distance where the peak occurrence of SAB bouts occurred (75-99 m in 2005, 125-149 m in 2006)] and 2) “Far” POCA distances [greater than the distance where the peak occurrence of SAB bouts occurred ( $\geq 100$  m in 2005,  $\geq 150$  m in 2006)].

a) 2005	POCA distance (m)	Percentage of focal follows (FFs) with SAB bouts (% of total FFs within each distance bin)	Percentage of focal follows (FFs) without SAB bouts (% of total FFs within each distance bin)
	0-99 ‡	28%	72%
	$\geq 100$	14%	86%

‡ Significantly higher proportion of SABs occurred during FFs with POCAs at 0-99 m compared to FFs with POCAs at  $\geq 100$  m (Chi-square = 4.3,  $P = 0.04$ , power = 0.5).

# Results

**Table 2.** Continued:

b) 2006	POCA distance (m)	Percentage of focal follows (FFs) with SAB bouts (% of total FFs within each distance bin)	Percentage of focal follows (FFs) without SAB bouts (% of total FFs within each distance bin)
	0-149 †	32%	68%
	≥ 150	19%	81%

† Reasonably higher proportion of SABs occurred during FFs with POCAs at 0-149 m compared to FFs with POCAs at ≥ 150 m (Chi-square = 2.6,  $P = 0.10$ , power = 0.3).

# Conclusions

- Results suggest that Southern Resident killer whales can respond to vessel presence by performing bouts of surface active behaviors (SABs)
- Southern Resident killer whales appear to react to close approaches and potentially a reduction in the distance or change in the nearest vessel's behavior
  - **Majority of SAB bouts occurred immediately prior to, during, or soon after the point of closest approach (POCA) by a vessel**
  - **SAB bouts occurred more often during focal follows with very close ( $< 150$  m) POCA distances and not as often during focal follows with far ( $\geq 150$  m) POCA distances**
  - **In 2005 the peak frequency of SAB bouts was at 75-99 m, with the majority of SAB bouts occurring within 0-199 m**
  - **In 2006 the peak frequency of SAB bouts was at 125-149 m, with majority of SAB bouts occurring within 0-224 m**
    - **Most SAB bouts in 2006 occurred when the nearest vessel was moving under power**
  - **Peak frequency of SAB bouts in 2006 was at a greater distance away from the whales than the peak frequency in 2005 due to changes in vessel operation practices from 2005 to 2006**
    - **Likely due to modification and increased vigilance of voluntary whale-watching guidelines as well as increased presence of government enforcement officials on the water in 2006**
  - **Average POCA distances for vessels (excluding the research boat) were greater in 2006**



# Conclusions

- Results have implications for extending the 100-meter “No-Go Zone” as defined by the *Be Whale Wise Marine Wildlife Guidelines for Boaters, Paddlers and Viewers*
- Further research is needed to assess the impact continued vessel traffic may have on endangered Southern Resident killer whales



# Acknowledgements

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